

How can be making non-commodity competitive?: A Case Study of Yamaha Corporation

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Abstract

This article focuses on a study of product architecture of musical instruments. In the musical instrument industry, only Yamaha became a major company in the world. Yamaha targeted the mid-priced segment rather than the high-end one. Gaining such customers, however, required a certain quality level of musical instruments even under mass-production. The case study shows how the company has promoted introducing the state-of-the-art technology and the automation to avoid manual variability, and outsourcing module components while ensuring the “integration” which is the key for manufacturing instruments. I demonstrate that the company enables to mass-produced instruments by committing to in-house manufacturing for finished products with the integration as well as its supporting mechanization.

Keywords : product architecture, musical instruments, YAMAHA, mass production, diversification

1. Introduction

The global musical instrument market amounts to approximately 19.7 billion dollar and provides total 125,466 jobs in 2010.¹⁾ By countries, US market is the biggest and amounts to 6.39 billion dollar, followed by Japanese market \$ 2.15 billion, Germany \$ 980 million, UK \$ 578 million and China \$977 million. In the industry, world's biggest company is Yamaha which records its sales of \$ 4.5 billion, having left the followers far behind (figure 1).

Figure 1. Top 10 Music and Audio Firms (2010)

	Company	Sales	Employees	Country
1	YAMAHA CORPORATION	\$4,496,280,000	26,816	Japan
2	ROLAND CORPORATION	\$1,020,140,000	2,750	Japan
3	KAWAI MUSICAL INSTRUMENTS MFG. CO., LTD.	\$762,753,000	2,975	Japan
4	SENNHEISER ELECTRONIC	\$673,454,000	2,200	Germany
5	FENDER MUSICAL INSTRUMENTS	\$625,000,000	2,800	U.S.A.
6	HARMAN PROFESSIONAL	\$522,736,000	1,575	U.S.A.
7	SHURE INC.	\$425,000,000	2,375	U.S.A.
8	STEINWAY MUSICAL INSTRUMENTS ²⁾	\$318,000,000	1,680	U.S.A.
9	AUDIO-TECHNICA CORPORATION	\$295,000,000	530	Japan
10	KHS/MUSIX CO.LTD.	\$293,000,000	4,050	Taiwan

MUSIC TRADE DECEMBER 2011 "The Global 225"

Musical instruments are divided roughly into two categories: one is an acoustic instrument such as piano, violin, flute, and etc. and the other is an electronic one such as electric guitar, synthesizer, and etc. The former is manufactured by small-sized studios where craftsmen have inherited traditional skill. Manufacturers have their own specialty; for instance, Steinway & Sons, Bösendorfer and Bechstein are called as the top three piano manufactures. French companies, Marigaux and Lorée take the flagship in oboe, and German company Heckel is the leading company of bassoon.

Figure 2. Musical instrument and its flagship manufacturer³⁾

Instrument	Flagship manufacturer
Piano	Steinway & Sons, Bösendorfer, Bechstein
Violin	Stradivarius (17 th century old Italian violin)
Flute	Muramatsu
Oboe	Marigaux, Lorée
Clarinet	Buffet Crampon
Bassoon	Heckel
Trumpet	Bach
Trombone	Getzen, Letzsch
Horn	Alexander
Saxophone	Selmer

Figure 1 and 2 indicate that top selling companies are not necessarily flagship manufacturers. Inferring from the number of world-jobs mentioned in the above, a flagship company is not a major company but small-sized companies which specialize in the certain category of musical instruments.

Manufacturing of musical instruments started in between 16th and 18th century in Europe, while Yamaha founded in late 19th centuries. The company has, however, grown up to be a full-line manufacturer with broad product lines, resulting in an overwhelming scaled company. Yamaha produces such instruments as pianos, flutes, saxophones, trumpets, drum, guitars, synthesizers and silent violins, ranging widely over keyboard instruments, wind and brass instruments, percussion instruments and electronic instruments. Although Yamaha does not capture a flagship of wood-related instruments, for example, violins, oboes, fagotto, etc., it has stood on a par with flagship companies in the category of brass instruments such as flutes, trombones and saxophones, since some players in famous orchestras use Yamaha's instruments.⁴⁾

Yamaha tried to expand a music market during the high economic growth in Japan by utilizing the Music School, while extending sales channel to schools to popularize music instruments. Those class rooms were set up in Western countries as well to obtain Yamaha users. It also established brass bands in schools nation-widely to dispatch instructors and hold contests for the purpose of expansion of wind instrument users.

In the categories of instruments Yamaha joined in late, traditional Western companies had already grasped flagships. For instance, Steinway & Sons seized a flagship of pianos, and Marigaux was a flagship manufacturer for oboes. Many instrument manufacturers captured respectively high-end users. Accordingly, Yamaha had to target beginners and middle level players for main customers in classical music. The company, however, extended the target to jazz and popular music as well as classic, and moreover, the development of electronic and silent instruments has driven the exploitation of new customers.

Nevertheless, the key for the growth did not limit to marketing policy. Manufacturing instruments to broad users is assumed to render Yamaha the top maker in the world. Then, to explore the reason, this paper focuses on the production system from the perspective of product architecture. We use the following data: publications regarding Yamaha and the industry, and interviews conducted between 2007 and 2010 to the people who involved in the company and the industry.

2. Prior Literatures on Product Architecture

Architecture is defined as “general pattern of functional, structural, and process partitioning and combination for artifacts” (Fujimoto, 2009) to understand the characteristics of system from the interdependence between constituents. Product architecture can be distinguished into the “modular” and the “integral” by degree of inter-dependency of components or modules. The former represents that a module functions itself and needs less signals or energy between modules so that the interface of modules are relatively simple. The latter represents that function corresponds to component not by “one-to-one” but by “plural-to-plural” and it requires fine tuning to design each component for which alignment is necessary. While the modular type allows for development of products with “dexterity of combination,” the integral type allows for raising the degree of completeness with “dexterity of integration”. Since these types are ideal, actual products are developed in spectrum pattern of them. Being composed by whichever modular or integral depends on a level of components to be argued. When a certain product is referred to modular, the product has strong modularity at the relative upper hierarchy of product function and/or structure (Ulrich 1995; Baldwin and Clark 2000).

Architecture can also classify an inter-firm alliance into two: the closed type and the open type. The former represents the complete design at in-house for interface between modules, while the latter represents the standardized design for interface between basic modules at industry level beyond boundary of firms.⁵⁾

Fujimoto and Yasumoto (2000), who analyzed architecture by industries, argued that the integral type can improve product functions by tuning components, and Japanese firms have strong capabilities of effective and proficient tuning. Since the design and development process of integral type products requires tight organizational alliance and deep communication, Japanese firms based on the long-term employment and trade have strong capability for the integral products. This capability allowed Japan to produce quality products such as vehicles, motorcycle and game software which require the dexterity of integration.

Considering from the upper hierarchy of musical instruments discussed in the paper, they can be positioned as typical integral products which require skillful integration such as tuning of musical interval and tone color.

3. Yamaha's manufacturing of Musical Instruments

(1) Transition of Diversification

Torakusu Yamaha, who succeeded in building a reed organ in 1887, founded the Yamaha Reed Organ Workshop in 1888 at Hamamatsu city. Next year, he also established the limited partnership Yamaha Reed Organ Factory to make it become Nippon Gakki Co, Ltd. (the present Yamaha Corporation). The company started to produce upright pianos in 1900 and grand pianos in 1902, accumulating skills regarding woodwork and painting.

In 1903, the company started to manufacture luxury wooden furniture, and metal propeller in the World War II. Utilizing this technology, it went ahead to manufacturing of motorcycle in 1950's, audio equipment in 1960's, and moreover, advanced to resort development as well as sporting goods such as boat and tennis rackets.

Yamaha also joined to manufacture harmonicas in 1914 and sold guitars in 1940's, entering into wind instruments to begin with trumpets. Later, the company acquired a long-established maker, Japan Wind Instruments in 1970, resulting in acquisition of broad product line of both woodwind instruments (i.e. saxophone, flute, clarinet, and etc.) and brass instruments (i.e. trumpet, trombone, tuba, horn, and etc.). It had refrained from joining violin to segregate from Japanese major maker, Suzuki Violin⁶⁾, nevertheless, it produced silent violin to enter into the field of electric instruments in 1997, launching acoustic violin in 2000. It also deals with electric instruments such as drum and synthesizer (table 3). Yamaha has pursued their mission which is to develop social business under a vision of "Affluent Life" and not to keep an eye on synergy effect with various instruments⁷⁾, thus, it has become a general musical instrument maker, dealing with from pianos to electric instruments.

While Yamaha has diversified their businesses, pianos constitute the core business (its component rate to sales in FY 2009 was 16.8%⁸⁾), and its market share is 70% in Japan. However, the market of pianos has matured in advanced countries. Yamaha aims at sales increase of other instruments as well as pianos to a large customer segment and Music Schools in Asian emerging countries such as China, Indonesia and etc.

Being a general music instruments, Yamaha has few top brands for high-end users. In recent years, although its woodwind instruments such as saxophones and flutes have been getting good reputations, flagship products of Yamaha are electric and popular products such as electric pianos, synthesizers and drums.⁹⁾ The company has aimed at Steinway & Sons in

Figure 3. The history of YAMAHA's diversification

	Musical Instruments	Others
1887	Organ	
1900	Upright piano	
1902	Grand piano	
1903		Furniture
1911		Plywood
1914	Harmonica(mouth organ)	
1915	Xylophone, Table piano, Table organ	
1921		Wood propeller for air plane, Special order furniture
1922		Gramophone
1926		Interior decoration
1931		Metal propeller for air plane
1932	Pipe organ	
1933	Accordion	
1935	Electronic organ	Book shelf, Chair
1945	Pianica	
1950	Full concert grand piano	
1954		HiFi player, Motorcycle, Organ school
1955		YAMAHA Motor Co., Ltd.
1959	Electone(electronic organ)	YAMAHA music school, FRP archery
1960		Motor boat(later transferred to YAMAHA motor co., Ltd.)
1961		FRP ski, Bath tub, R&D(Iron/Aluminum/Copper)
1962		YAMAHA Recreation Co., Ltd.
1964		First Electone competition
1965	Trumpet, Marimba	
1966	Electric guitar, Drum, Solid guitar, Amplifier	YAMAHA Music Foundation
1967	Saxophone, Trombone, Euphonium, Tuba	NS speaker, First Light music competition), Resort development(Nemu nosato)
1968	Piccolo, Flute, Clarinet, Cornet, French horn	NS stereo system
1971		IC
1972	Co-development with Wien Philharmonic(Brass)	First Junior original concert(JOC)
1973		Tennis racket
1974	Synthesizer, Recorder	PA mixer, Speaker system, Resort development(Tsumagoi)
1975		Unit furniture, System kitchen
1976	Electric grand piano	PA power amplifier, PA speaker system,
1980	Porta sound	R&D(Titanium alloy), PA mixer
1981		Ski wear, Badminton, LSI, YAMAHA piano technical academy
1982	Piano player	Golf club, CD player
1983	Clavinova, Digital synthesizer	Custom LSI, Personal computer
1984		Industrial robot, LSI for FM sound, LSI for graphics
1986	Piano player with MIDI	DSP effecter, Digital sound field processor
1987		Wind MIDI controller, English school, First Band Explosion Competition
1989		Sound proof room
1990		YAMAHA Resort Co., Ltd., Super Woofer, AV amplifier, Music sequencer
1991		Thin magnetic head, Titanium golf club, Resort development(Kiroro), Active speaker
1993	Silent piano	Computer music system, Karaoke communication system (with Daiichi Kosho Co., Ltd)
1995	Electronic grand piano	Remote router
1996	Silent session drum	Theater sound system in the Living room
1997	Silent violin	
1998	Silent cello	First prize in Tchaikovsky piano competition: Denis Matsuev with YAMAHA
1999		Internet music distribution system MidRadio, Multimedia amplifier with USB
2000	Acoustic violin, Silent base	Melodic ringtone
2001	Silent guitar	Music school for adults
2002	Silent viola	First prize in Tchaikovsky piano competition: Ayako Ueno with YAMAHA
2008	Bösendorfer, TENORI-ON	
2010		First prize in Chopin piano competition: Yulianna Avdeeva with YAMAHA

pianos which are key products for Yamaha but it fails to achieve. Yamaha recognized that dealing with professional-use products only was not profitable and non-brand products could pay even without top brand products which professional musicians use¹⁰⁾ to expand the instruments market.

In fact, Yamaha also frustrated that they could not take a flagship for piano business. For this reason, they acquired the long-established European piano maker, Bösendorfer in 2008. The purpose of this acquisition was as follows: adding alternatives by attracting top artists' interests, and showing Yamaha's presence as defensive meaning toward start-ups in China.¹¹⁾ In

the past, entering into wind instruments by merging Nikkan, Yamaha has developed and expanded products in-house. The company, however, has come to understand the necessity of having top brands to appeal to top artists and to compete with low-end made in Asian countries.

(2) Manufacturing and Contractors

Custom-made and mass productions constitute Yamaha's music instruments. This two way production comes from "the method of quantitative data dependent judgment for measuring musical intervals and resonance, because the company cannot match the history and tradition Western top-ranking piano makers.¹²⁾" Consequently, the company invested a lot in production lines for pianos from 1970's to 80's. The production lines have been automated, yet some hand work areas have remained for integration. The handwork areas apply to not only custom-made pianos but also mass production ones. Yamaha aims at automation to avoid variance by hand and secure uniformity by replacing manpower with machines. Investment in equipment for wind instruments proceeded in 1980's with installation of robots, but fundamental manufacturing has unchanged. A Yamaha employee mentions that materials and effort are critical to piano and as is effort to wind instruments.¹³⁾ The difference of custom-made and mass production is the scale of standardization, and custom-made requires more integrated processes.

Yamaha's suppliers manufacture and process the most components and parts of the instruments. Major companies Yamaha and Kawai have many suppliers in Hamamatsu where hierarchy of manufacturing instruments is built. For this reason, even small-sized piano makers can build their original brand pianos using these suppliers.

(3) Manufacturing for Representative Music Instruments

This section explains the characteristics of instruments and the manufacturing process for pianos, violins and saxophone. It is pianos which require the most parts/components among all the instruments. The present violins cannot still compete with Stradivarius crafted in between 16th and 17th century. Many companies manufacture violins to catch up with Stradivarius, and yet their products sound differently even with the same dimensions. Violins require craftsman's skill in assembling bodies and more details. Saxophones have brass bodies but sound with quaver of a reed attached to a mouthpiece. Having the both characteristics of wooden and brass instruments, saxophones are typical wind instruments.

a) Pianos

A fortepiano, which was invented around 1700, came to be manufacture in Germany thirty years later, being developed mainly in England in the period of the Industrial Revolution (Oki, 2010). When piano playing moved from the salons of kings and lords to guest rooms of newly rising classes and moreover concert halls with capacity of a few thousand, the volume of pianos was required to be bigger. Following the change, action and frame were significantly reformed, fixing the present form.

From the late 19th century and onwards, adding to the existing makers such as Bösendorfer and Stricher in Vienna, and Erard, Preyell and Herz in French, start-ups such as Bechstein and Blüthner in Germany, and Steinway & Son in US were ascendant to enter fierce competition. In Europe, the obsession of traditional manufacturing process made England drop out the competition, while German makers extended their market share. As Steinway and Chickering in US accelerated innovation, the center of manufacturing moved from Europe to US. In 20th century mass-production advanced in US, piano manufacturers put the world market in perspective to start sales. After the WWII, Yamaha's launch into the world market rendered quality low-priced pianos become widespread.

Pianos are composed of many parts/components made of wood, iron, felt, etc., having complex mechanism and being mechanical. According to Steinway which manufactures the world leading grand pianos, more than 12,000 parts and components constitute a piano.¹⁴⁾ A report discloses one episode of Steinway.¹⁵⁾ Since Steinway discarded 65% of components covered with cashmere cloth, they changed the cloth from cashmere to Teflon in 1962. Then, in the next year they got complaints of noise somewhere, so that they took a long time and much effort to investigate the source of noise, searching for 12,000 parts or pieces. This episode represents typical example of piano's complex mechanism and the importance of architectural integration.

When tapping keyboards of a piano, the mechanism called "action" functions to move a hammer to pluck strings. Strings vibrate to make sound, and soundboard resounds to amplify the sound. To make resonance and harmonic, approximately 230 strings are required. This causes tension of about 20 ton, and the tension is balanced by wooden and iron frames, and their supports. The determinants of quality of pianos are mechanism and technology of parts/components such as frames, soundboard, action, keyboard, strings and pedals.

The production process of grand pianos is follows: (1) selecting wooden materials (2) drying (3) manufacturing soundboard (4) assembling supports (5) sealing sideboard with

supports (6) installing soundboard (7) manufacturing and attaching frames (8) putting strings in (9) attaching keyboards (10) various tunings (11) finishing. In this process, wooden materials are the critical factor to determine sound and outer appearance of pianos. Although Steinway purchases quality wooden materials only, about a half of purchased spruce is good enough for piano.¹⁶⁾ Soundboard is made of a board which has straight grains throughout the length of it. Wooden materials are set aside unused outside a factory at least one year to be dried in a dryer chamber for several days. After that woodworkers sort wooden materials again. Parts of pianos are made of the selected wooden materials to be rims, sound boards, hammers, etc. Those processes are essential to manufacturing of pianos.

On the other hand, Yamaha has developed their original aging drier technology with parallel use of natural drying to allow for shorter drying time. They say the technology is based on standardization to avoid drying variance under the drying conditions obtained by measurement for a long time. They also insist that the technology can reduce the unnecessary drying time and allow for estimating the timing of outgoing at incoming. It also contribute to smooth production when a large volume of dried woods is handled at production lines due to the rational drying plan, minimum inventory and stable moisture content of inventory woods.¹⁷⁾

Steinway has come to cut wooden material with machines for upper lids and legs of pianos, and yet, rims are made by hands because they insist that automatic fabrication of rims leads to taking the soul out of Steinway's pianos.¹⁸⁾ Even if woods are strictly processed within errors of plus or minus 0.076 millimeter, manual handling may cause slight variance. Steinway has no operating manual and workers have engaged in the same job for 20 to 30 years to learn it through the observation on a predecessor, taking over knowledge through oral instructions from senior workers.

Oppositely, Yamaha accelerated modularization on wood working parts for mass production (figure 4). For instance, Kitami Wood Company located in Maruse city of Hokkaido, where *Picea glehnii* trees are produced, sold their raw timber wholesale to Yamaha as materials. Later the company has come to supply all the soundboards demanded by Yamaha as completed modules by their own sawing, cutting and drying. Soundboards are prime parts which determine the sound of pianos, and in the past Yamaha accumulated know-how through in-house fabrication but they provided Kitami Wood with the know-how to switch to outsourcing.

Action is also the heart of pianos and the integration technology is essential for action. The

part linking a keyboard to action determines whether or not sound resonates as a player expected. Easiness to play is a key factor for customers to choose a piano. Action of Yamaha is composed of 80 parts or more per one key, being finished with high precision of 0.05 millimeter.¹⁹⁾ A touching area is finished after several integrative processes. Yamaha says that it is critical for processes such as stroking, tuning and sounding to be conducted with balancing as a whole. When finishing the adjustment, technicians play pianos to check the desirable balance.²⁰⁾ The scrupulously integrative work is conducted to mass-produced pianos as well as custom-made.

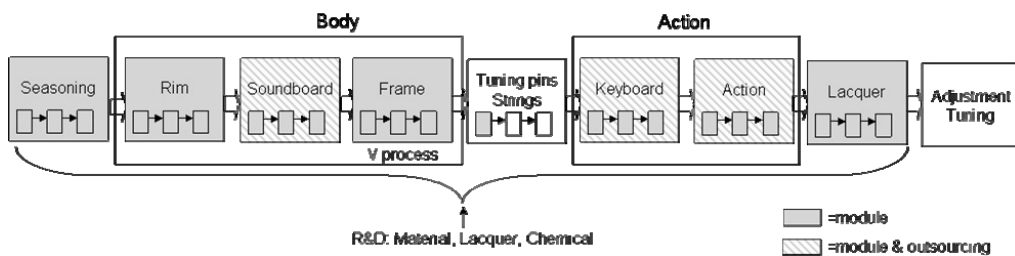


Figure 4. Yamaha's product architecture of piano

b) Violin

Andrea Amati is recognized to have completed a violin with the present shape as a musical instrument in Cremona of Italy in 16th century. Violins made by Stradivari, Guarneri, etc. before 1820, are referred to the “Old Italian” and are the most expensive, so that professional players and collectors highly value them (Oki, 2009). After that between 1890 and 1940, Italy experienced the second peak time and violins, which were made by approximately 250 master craftsmen, are called as “Modern Italy” and those violins are highly evaluated as concert violins.

After the Industrial Revolution, mass production by division of labor has spread widely, and violins were made by the traditional handicraft or the mass production with profit-seeking. Mass produced violins were manufactured mainly in Germany and Bohemia but not in Italy which guarded the tradition for not making mass-produced musical instruments.

The manufacturing process of violin is as follows: (1) designing and framing (2) selecting the wood (3) fabricating rims (4) carving the front and back (for the arching and the optimum distribution of thickness) (5) purfling²¹⁾ (6) making the f-shaped hole (7) matching bass (8) assembling body (9) setting the neck (10) varnishing (11) positioning the sound post and the

bridge. Although components such as the front and rear panels, neck and scroll are feasible for modularity, the operations of assembling and adjustment are hard to be modular. Actually, modular kits of components are sold, and cheap violins are manufactured by assembling a kit made-in China even in Cremona. On the hand, expensive violins are not modularized but fabricated with hand-made components by being carefully integrated.

According to the survey of violin manufacturers (Oki, 2009), workers mentioned that they handle with special care the following processes: choice of wooden material, neck set, positioning the sound post and bridge, carving the front panel, varnish application and matching bass-bar. Since violins are wooden musical instruments, the key operations are the careful inspection of woods and the appropriate handling and shaving to respective woods. Also, out of manufacturing process, neck set, positioning the sound post and bridge and matching bass-bar require integration. In Cremona where one craftsman handles all the processes, starting from the designing and choice of wood, the process of shaving the front panel, which affects the beauty of sounds, requires the skillful integration and is the most elaborate process.

Meanwhile, Yamaha challenges Old Italians with their heritage such as the CAD measurements for exquisite instruments, the aging dryer technique for pianos and furniture, the paint spraying technique for motorbikes, and the varnishing technique for pianos and guitars to improve the precision and quality of components, integrating with these operations by hand. The director says that the original skill for making violins takes only 34% in woodcraft process and 51% in varnishing process²²⁾ (figure 5).

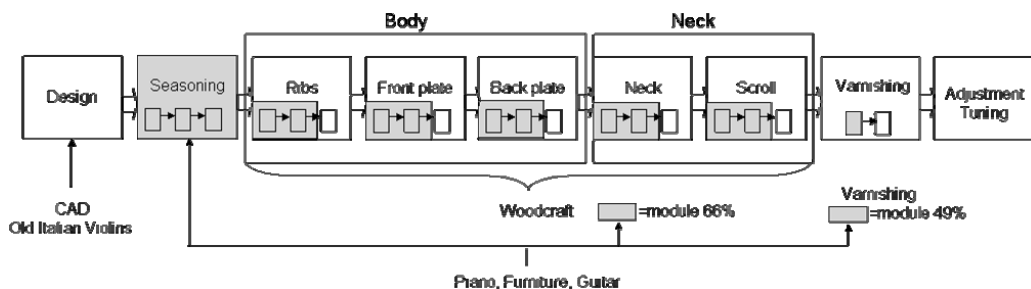


Figure 5. Yamaha's product architecture of violin

c) Saxophones

In 1846, a saxophone was invented by Adolf Sax in Belgium. Although the body is made

of metal, saxophones are a sounding body of single reed so that they are classified as the woodwind, including five types from the soprano to the baritone saxophones. The saxophone basically consists of four parts: the suction tube (neck/mouthpiece), the second tube (body), the first tube (U-shaped tube: bow), the upturned flared bell. A tube body has 25 tone holes. The tone hole is covered with the pad and the key; the lever is attached to press holes out of reach at the same time. Some players may fabricate the reed or buy it on the market to scrape for fine tuning, because when blowing they feel different, depending on its cutting and/or stiffness.

The saxophone consists of approximately 600 parts and pieces. The shape of the basic model is a cone tube tapered by 3 degrees. Tone colors and musical intervals vary with the taper. Yamaha insists that “Saxophones can produce a sound very close to a human voice owing not to its cylinder shape but to the tapered shape. Therefore, you can play a saxophone emotionally and it makes saxophones suitable for solo playing. Strong taper is the best suited to the Jazz play.²³⁾” For classic music, since saxophones are played with other instruments, they are less tapered and the cylinder-like tube is shaped for easy sound control and precise interval. Conversely, saxophones for jazz use need to make big sound and its huskiness is considered as original sound so that such a saxophone has the wider bell flare.

The manufacturing process of saxophones is as follows: (1)bell (welding → hammering → die casting → drawing at the tone holes), (2)U-shaped tube (welding → bulge processing → drawing at the tone holes), (3)attaching bell to U-shaped tube (soldering → engraving → buffing → plating), (4)the second tube (welding → tube drawing → drawing at the tone holes → buffing), (5)assembling, finishing and completing (installing keys → assembling body → adjustment → inspection), (6)neck (welding → bending → processing octave sound holes → soldering key posts → buffing → plating → attaching octave keys).

Although Yamaha utilizes the 3D computer technology before making the prototype to ensure that a player can press the tone hole without touching the body or key post, the most process is still handicraft processed. For instance, workers mold the bell by hammering one by one to say “The precise fitting is very important to ensure the quality of the bell flare. We fill the seam by roller to flatten and then shape the upturned flared bell.²⁴⁾” The process of brass shaping, heating and washing is repeated until the tough metal is made a thickness of 0.65 to 0.7 millimeters. Then, each 2 key posts are precisely attached to totally 33 keys by soldering one by one. Yamaha says “A worker carefully assembles a set of saxophone one by one. Now, this factory produces 25 sets of saxophone and this amount is the top production volume in the

world.” Contractors construct keys and pads, to finish with gold-plating. Yamaha’s skilled workers solder to assemble those parts by hands.

Yamaha responds to any professional demands by customizing the design of instruments, while incorporating such designs into the know-how for standardization to utilize the mass-production. Accordingly, Yamaha divides the manufacturing processes by taking charge of the planning and the designing, while contractors produce parts and pieces (figure 6).

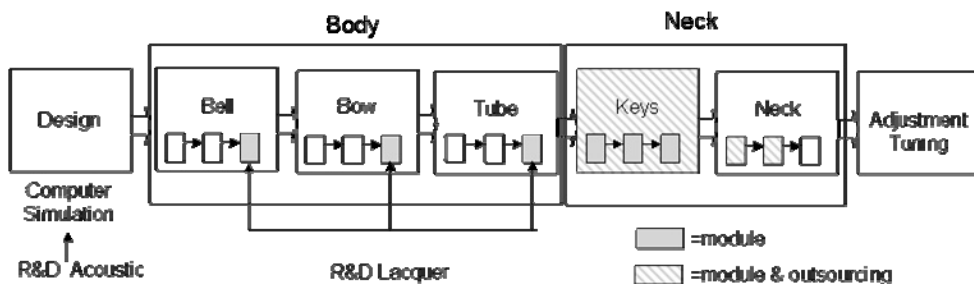


Figure 6. Yamaha's product architecture of saxophone

(4) Yamaha Production System

Reviewing from the above, we conclude that the characteristic of Yamaha's production system is the integrity of automated mass-production by advanced technology with hand working. They have positively adopted the scientific measurement of interval and acoustics, the aging drier technology for woods and the measurement by CAD, promoting the automation of production lines. The critical tip in automated instrument manufacturing, which requires architectural integration, is not human-less but automation for securing uniformity to avoid the manual variability. They have also promoted the modularity of parts to increase the proficiency for outsourcing to contractors, while the core parts such as operability and tone are handled with workers in head office's factory to secure the quality. The process is applied not only to custom-made but also to mass-produced items.

Mass-production for musical instruments is not necessarily required as it is for the volume of vital commodities such as automobiles. In this sense, Yamaha becomes feasible for the proper mass production without abandoning careful integration.

4. Discussion and Conclusion

This case study shows how the company has promoted introducing the advance

technology and the automation to avoid manual variability, and outsourcing parts and pieces while ensuring the “architectural integration” which is the key for manufacturing instruments. I demonstrate that the company is able to mass-produced instruments by committing to in-house manufacturing for finished products with the integration as well as its supporting mechanization.

What made Yamaha become a major company? While traditional manufacturers are seen as the premium manufacturers in the musical instrument industry, Yamaha succeeded in the transformation to a leader from a follower through its diversification strategy. In the music business, Yamaha developed the music enthusiast base through music schools and expanded the market through providing sufficiently high-quality musical instruments at reasonable prices, which was realized by mass production, hence greatly contributing to the growth of the music industry. Due to the late start as a musical instrument manufacturer, Yamaha needed to target beginners and intermediate users, who generally are not capable of evaluating products, with a technical development. To that end, Yamaha established a divisional mass production framework with the introduction of scientific innovations in the production of musical instruments, which were previously by and large handmade. Yamaha’s on-the-mark marketing strategy is owed to winning over the volume zone, leading to large profits.

On the other hand, although Yamaha has stood on a par with a leading company in the category of the woodwind such as flute and saxophone and the brass which could be easily standardized, the company does not still get reputation from high-end segment of piano, wood-

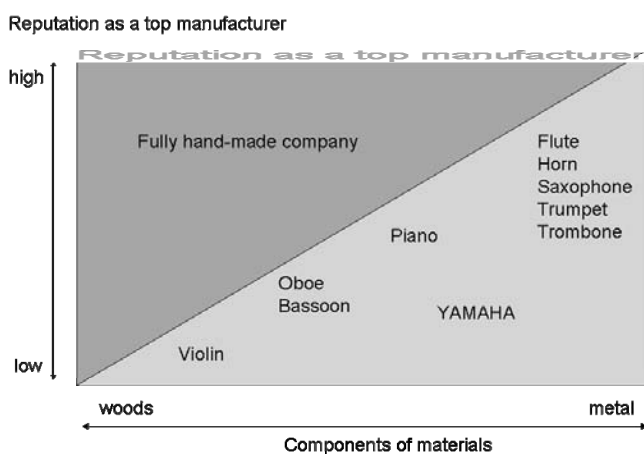


Figure 7. The reputation of YAMAHA as a flagship company

wind such as oboe and bassoon, and strings such as violin, viola and cello which are made of wood under the “ultimate integration.” Instruments demand “connoisseurs” to judge good wood for processing as well as unquantifiable “sound” and “sonance,” thus the instrument manufacturing has been competed in the “Invisible Dimension”. This characteristic makes customers keep traditional brand belief, requiring a long time to evaluate a new comer.

Business model research has been progressed especially in the automotive industry, and it is expected to advance further on a global scale modularity in line with the increase in electric vehicles. Yamaha has succeeded in establishing the original mechanism of combining “modular” and “integral” processes. I imply that many major companies in the more sensitive fields such as music and visual arts can learn from the case study how they can survive in the world market especially in the Invisible Dimension of competition.

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Notes:

- 1) Music Trades December 2011 (2011) “The Global 225”
- 2) Includes Corn-Selmer
- 3) Hearings from professional musicians in Japan
- 4) Yamaha Co., Ltd. Hiroo Okano
- 5) In this paper we don’t argue close/open topics, because standardization is not popular in musical instrument industry except electronic instrument.
- 6) Oki (2007)
- 7) Yamaha Co., Ltd. Wataru Miki
- 8) Total company sales estimates 413 billion yen in 2010.3. (piano 69.4 billion yen; acoustic piano 40.1 billion yen, electric piano 28.7 billion yen, hybrid piano 0.6 billion yen. By Yamaha group midterm management plan 2010.4-2013.3. (2010.4)
- 9) Yamaha Co., Ltd. Misao Tanaka
- 10) Yamaha Co., Ltd. Wataru Miki
- 11) Yamaha Co., Ltd. Wataru Miki
- 12) Maema and Iwano (2001) p. 147.
- 13) Yamaha Co., Ltd. Hiroo Okano
- 14) Steinway & Sons HP.
- 15) Utamakura Piano Factory HP. “The secret of Steinway in NY.”
- 16) Barron (2006) p. 80.
- 17) Katou (1966) pp. 55–56.

- 18) Barron (2006) p. 8.
- 19) Yamaha Co., Ltd. HP. "Making YAMAHA Piano"
- 20) YAMAHA brochure "Making YAMAHA Piano"
- 21) A thin sandwich of veneer inlaid around the entire edge of violin which serves to reinforce the plates and prevent cracking along their edges.
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Interview Lists

Yamaha Corporation: Hiroo Okabe (Director), Wataru Miki (Executive Officer), Toshiyuki Nihashi (Corporate Communication Group General Manager), Misao Tanaka (CC Group Deputy General Manager), Tomio Muramatsu (Piano Production Deputy General Manager), Toshikazu Niwata (Brass, woods and percussion Production Manager), Toshiyuki Nakamura (Brass, woods and percussion Marketing, Associate Manager), Yasushi Itoh (CC Group Associate Manager), Hiroshi Nakatan (Strings Production Manager), Yoji Abe (Strings Sales Group)

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ヤマハの楽器製造に関する一考察

大 木 裕 子

要 旨

本稿では楽器の製造に焦点をあて、ヤマハの事例を取り上げる。楽器業界では欧米の伝統ある家内工業的な専門企業が各楽器のフラグシップを握っているが、経営規模では日本のヤマハが世界最大手として、他社を大きく引き離している。楽器メーカーとしては後発であったヤマハは、ハイエンドユーザーを狙うよりは、まず初心者から中間層のボリュームゾーンの顧客を獲得する必要があった。このためヤマハでは、楽器の製造において最先端技術を取り入れ、人によるバラツキを減らすための自動化を進めると共に、部品をモジュール化することで外注により効率化を図ってきた。一方で、完成品の擦り合わせ技術の内製化にはこだわり、それをサポートする機械化も進めてきた。こうして、擦り合わせが要となる楽器においても量産を可能とし、ボリュームゾーンの顧客に満足感を与える楽器を供給することで、ヤマハは総合楽器メーカーとして大企業に成長することができた。

キーワード：製品アーキテクチャ、楽器製造、ヤマハ、大量生産、多角化